

## **Influence of *in ovo* Administration of Varying Levels of Glucose on the Hatchability Traits and Humoral Immune Response of Arbor Acres Broiler Chickens.**

**Akingbade, A.O<sup>1</sup>., Sogunle, O.M<sup>2</sup>., Jinadu, K.B<sup>1</sup>., Aromoye, R.A<sup>3</sup>., Orimogunje, R<sup>1</sup>., Saka, A.A<sup>1</sup>., Adewumi, M.O<sup>1</sup> and Osinubi, A.A<sup>1</sup>.**

<sup>1</sup>Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan.

<sup>2</sup>Department of Animal Production, Federal University of Agriculture Abeokuta, Ogun State.

<sup>3</sup>Agrobamagen Nigeria Ltd. Apata, Ibadan.

**Corresponding Author:** [akingbade.abbas@yahoo.com](mailto:akingbade.abbas@yahoo.com) Tel No: 08023261171

**Target Audience:** Poultry companies, Breeder farms, Poultry farmers and Scientist.

### **Abstract**

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*In ovo feeding is a nutritional strategy employed during the embryonic stage to optimise growth performance and immune functions for sustainable poultry production. This study was conducted to investigate the effects of in ovo administration of varying levels of glucose on hatchability traits and humoral immune response of Arbor Acres broiler chickens. Two hundred (200) fertile eggs of Arbor Acres strain of broiler chickens were used for the experiment. Candling was done on the 14th day of incubation and viable eggs were distributed into five (5) treatment groups consisting of the control -T<sub>1</sub> (no in ovo injection), T<sub>2</sub> (Sham group-0.5ml of sterile water/egg); T<sub>3</sub> (50mg glucose per egg); T<sub>4</sub> (75mg glucose per egg); T<sub>5</sub> (100mg glucose per egg) in a completely randomized design. The in ovo injection was carried out on 18<sup>th</sup> day of incubation before being transferred to the hatcher. The post-hatch chicks were replicated based on the number of chicks hatched from each treatment. Data collected on the hatching traits and immune response were subjected to descriptive statistics using 2013 Microsoft excel package. Result of hatchability showed that the hatchability percentages in T1-T5 were 83.33%, 80.00%, 63.33%, 63.33% and 43.33%, respectively. The weight of newly hatched chicks were 37.57g, 37.37g, 37.44g, 36.80g(T1) and 36.57g(T2) Results showed that chicks from eggs injected with 50 and 100 mg glucose had highest immune response to sheep Red blood cell (SRBC) antibody titre. The study concluded that glucose can be injected in ovo at 50-100 mg per egg to influence hatchability and humoral immune response of broiler chickens.*

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**Keywords:** *In ovo feeding, immune response, hatchability*

**Description of problem**

Meeting the increasing global demand for protein requires enhancing the efficiency of converting less abundant protein sources, such as soybean meal and vegetables, into high-nutritional-value proteins like meat, milk, and eggs [1]. Within this framework, the technique of in-ovo nutrient injection provides the poultry industry with an alternative strategy to boost both hatchability rates and the initial body weight of newly hatched chicks [2]. This approach facilitates the expedited growth of embryos and enhances their nutritional well-being, ultimately leading to elevated hatching weights and accelerated growth rates [3]. As the incubation process nears its conclusion, there is a notable surge in the development of digestive organs, emphasizing the substantial energy demand required to support normal embryonic growth.

The shift from embryonic development to the independent status of chicks poses nutritional challenges that affect the viability and growth of late-term embryos and newly hatched chicks. Firstly, there are limitations in the nutrient reserves available within the egg, which are crucial for sustaining embryonic development and body reserves (such as glycogen, muscle tissue, and yolk) until hatching (4).

Secondly, the gastrointestinal tract (GIT) of chicks has a limited capacity to digest nutrients from an external diet rich in carbohydrates and proteins until it fully matures. These nutritional constraints can be addressed through two methods: "Immediate Post-Hatch Feeding," which involves providing food to chicks right after hatching in the hatchery, and "In ovo Feeding," which entails administering nutrients directly into the amniotic fluid of late-term embryos [4].

and often change depending on consumer's preferences. Pigs have been used widely in biomedical research owing to their physiologic and anatomic similarities to humans (models for studying diseases such as gastrointestinal, renal, and cardiovascular diseases in humans (12)). Pigs are seen as popular and valuable animal models for studying diseases such as gastrointestinal, renal, and cardiovascular diseases in humans (2, 25), and they serve as organ donors in xenotransplantation (5).

**Table 1: In ovo administration**

Treatment groups	In ovo administration
1	Control
2	Sham (0.5ml of sterile water)
3	50 mg of Glucose dissolved in 0.5ml sterile water
4	75 mg of glucose dissolved in 0.5ml sterile water
5	100 mg of glucose dissolved in 0.5ml sterile water

They were all injected at 0.5ml per egg.

**Candling and distribution of eggs**

The eggs were candled on the 14th day of incubation for fertility/viability test. This is done to ascertain those eggs showing viable embryos under lamina flow. A total of 150 fertile, viable eggs were selected (75% fertility) and allotted into 5 treatments of 30 eggs per treatment of *in ovo* administration.

**Procedure of in ovo injection of varying levels of Glucose**

On the 18th day of the incubation process, injection sites were identified and sterilized

with methylated spirits. Subsequently, a pin hole was meticulously made on the surface of the air sac with a specialized pin. Injections were administered into the amniotic cavity at the broad end of the eggs, utilizing 24-gauge hypodermic needles measuring 19mm in length, according to the method standardized by [11]. The injection point was sealed using melted candle wax and the eggs were relocated to the hatching apparatus.

### Post-hatch Chick Management

The Post hatch chick rearing was done at the Teaching and Research farm of Federal College of Animal Health and Production Technology, Moor Plantation, Apata, Ibadan. A total of 100 chicks were hatched (66.67% hatchability); 25 chicks (83.33 % hatchability) from T1, 24 chicks (80.00% hatchability) from T2, 19 chicks (63.33% hatchability) from T3; 19chicks (63.33% hatchability) from T4; 13 chicks (43.33% hatchability) from T5. The birds were brooded for a period of one-week, same commercial feed and drinking water were provided *ad libitum*. The birds in each treatment were replicated 3 times. The chicks were vaccinated against Newcastle and infectious bursa disease (IBDV) at day 12. The experiment was conducted for a period of 49 days. The experimental design used was completely randomized designs. Data were collected on hatchability traits such as:

1. Egg weight(g) – was determined by using sensitive weighing scale
2. Chick weight(g): -chicks weight was measured using sensitive weighing scale
3. Chick to egg ratio: - This was calculated as ratio of chicks hatched to the total number of injected eggs for each replicate per treatment.

### 4. Hatchability %=

$$\frac{\text{No of hatched chicks} \times 100}{\text{No of fertile eggs injected}}$$

The hemagglutination (HA) test, a measure of antibody titer, was determined following the HA method as described by [12] and [13].

### Statistical Analysis

The data collected on hatching traits and immune responses were subjected to descriptive statistics using 2013 Microsoft excel package.

### Results

The effect of *in-ovo* injection of glucose on hatching traits of fertile eggs of Arbor acre chickens is presented in figure 1. The highest chicks weight of 39.40g was obtained in 75mg glucose (T4) administration, followed by 37.27g (T3), 37.23g (T5) respectively and the lowest chicks weight of 36.57g was recorded from the sham group(T2) and the control (36.80g). Highest hatchability of 83.33% was obtained in fertile eggs with no injection T1 (control), followed by the sham group T2 (80% hatchability); 63.33% hatchability in eggs injected with 50mg(T3) and 75mg(T4) glucose respectively; while 43.33% hatchability was obtained in eggs injected with 100mg glucose. The chicks to egg ratio of 0.83 was observed in chicks from eggs on control (T1) while the lowest value of 0.42 was recorded in chicks that resulted from eggs injected with 100mg of glucose(T5).

The effect of *in-ovo* administration of varying levels of glucose on the humoral immunity of Arbor acre broiler chickens is presented in Figure 2. The result obtained showed that the humoral immune response of the chicks was influenced by the *in-ovo* administration. The highest humoral immune

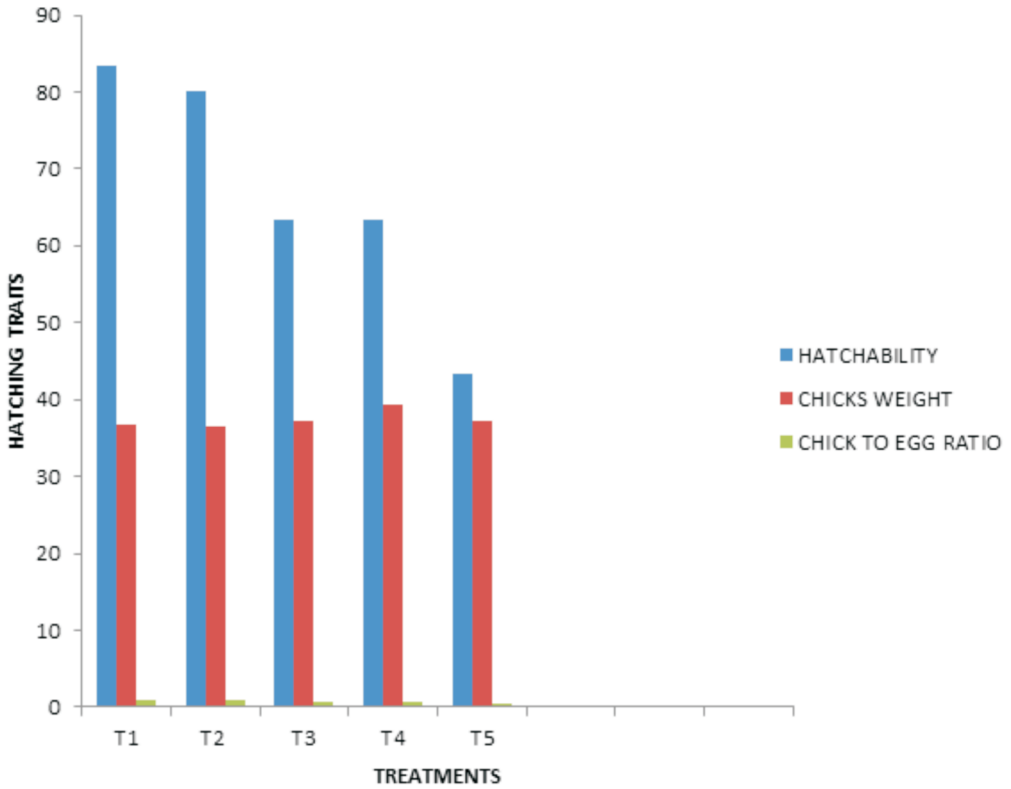


Figure 1: Effects of in-ovo administration of varying levels of glucose on hatchability traits of fertile eggs of Arbor Acre broiler chickens.

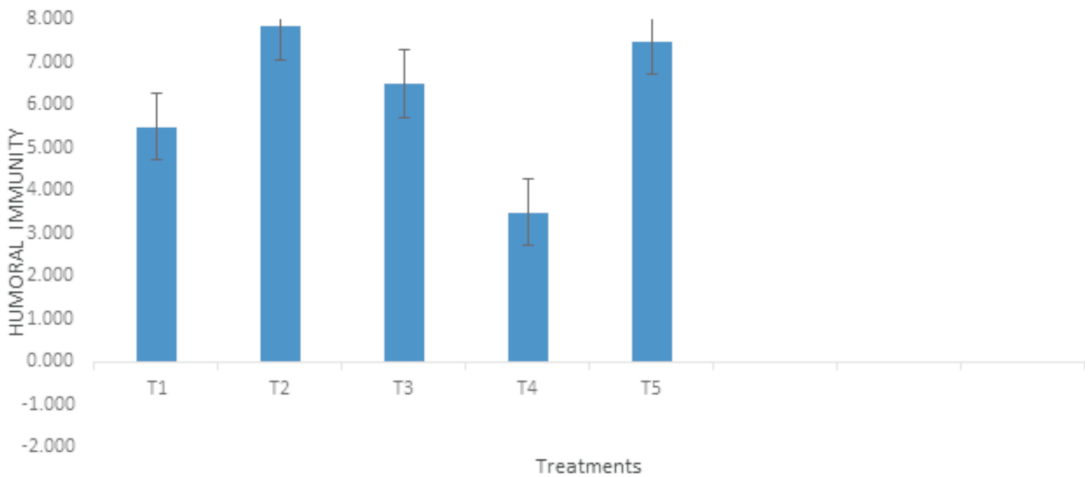


Figure 2: Effect of in-ovo administration of varying levels of glucose on the humoral immune response of Arbor acre broiler chickens.

response (7.83) was obtained in chicks from sham group followed by eggs injected with 100mg of glucose 7.50 in T5 followed by 6.50 in T3 while the lowest (3.50) humoral immunity was obtained in chicks from eggs injected with 75mg glucose (T4).

## DISCUSSION

In the present study, the weight of newly hatched chicks was higher (37.57g[T4], 37.37g[T5], 37.44g[T3]) following the *in-ovo* glucose injection compared to the control (36.80g[T1]) and sham groups (36.57g[T2]). It has been established in previous studies that the initial weight of chicks at hatching is a critical indicator of their eventual market weight, although this relationship may vary among different strains. The relevance of initial hatch weight to final market weight is becoming more pronounced with broiler breeding companies' ongoing selection for rapid growth traits [14]; [15]and [16]. This observation is consistent with findings from [17], which indicated that carbohydrate treatments significantly alter the body weight of one-day-old chicks or during the subsequent breeding period.

The results on hatchability was in agreement with the work of [18] and [19] who reported lower hatchability of the treatment groups than the control and the sham group. [20] also reported that eggs injected with 0.5ml of deionized sterile water containing 50; 75; and 100mg of glucose did not differ significantly. The result is in agreement to the work of [21], that reported significant hatching weight as compared to the control and sham group when injected glucose at 15%, 20% and 25% glucose.

Conversely, [22] observed a decrease in hatchability when fertile eggs were injected with 75mg or 100mg of glucose in 0.5ml

deionized water into the albumen after seven days of incubation. They speculated that the reduced hatchability could be due to the injection's location under the air sac, potentially interfering with the embryo's respiration. Despite this, [23] noted that such injections might still be advantageous for promoting growth in chickens.

Humoral immunity is majorly indicated by B-lymphocytes which specifically produce immunoglobulin or antibodies when stimulated by microbial exposure or other antigens [24]. The use of sheep red blood cell (SRBC) to assess the humoral immune response through the production of haemagglutinin is common because it does not involve the use of pathogenic agents [25]. This study reveals that chickens on *in-ovo* injection with sham[T2], followed by T3 and T5 had highest immune response to sheep red blood cell (SRBC) antibody titre.

The positive effect of *in-ovo* administration of glucose and threonine on hatchability and humoral immune response can be corroborated by the fact that embryo needs supply of glucose at later term embryonic stage according to [26]. This result is in agreement with the work of [27] and [28]. The values obtained in this result is higher and better than the value obtained by [29] who reported 6.0 for antibody titre for Funaab Alpha chicken. The humoral immune response of the birds obtained in this study buttressed the observation that *in-ovo* administration of glucose can improve immune response of chicken.

## Conclusion and Application

1. It can be concluded that *in ovo* injection of Glucose at 50mg- 100mg per egg can improve the hatchability traits of broiler eggs.

2. In-ovo injection of glucose at 50 to 100mg/egg improved the humoral immune response of broiler chickens.
3. It is recommended from this study that *in ovo* injection of glucose at 50mg can improve hatchability and humoral immune response.

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